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Agricultural Memorandum No. 346

Accumulated Temperature Above 10°C in Relation to Maize

by Dr M Hough

Values of average accumulated temperature above 10°C for the six months May to October between 1950 and 1969 have been computed by Thom's method for stations in southern England. The values are plotted on the accompanying map. This method leads to some underestimate in May and October, amounting to about 9% of the seasonal total. This error was found for East Malling in Kent, by comparing degree days evaluated using daily maximum and minimum temperatures and by Thom's method over the same 20 years.

Maize is normally sown at the end of April or beginning of May and is harvested late in October or in November. Agricultural Memorandum No. 332 suggested that a mean value of 762 ± 60°C - days are required from sowing to 40% grain moisture content and for a failure of reaching this maturity in 1 year out of 10. The map then, is suitable for determining the areas in UK where the mean value of 762 is exceeded on the 1950-1969 figures.

There are some points of difficulty however. In the Russian work, upon which the figure of 762°C-days is based, there is no mention of the method used for finding accumulated temperature. In other papers they use the day mean less 10°C and this method has very likely been used for the above figure. Shellard (1959) compared Thom's method with five other methods and it seems that the Russian method may give values slightly below Thom's in months when the mean is near 10°C. In order to construct a map, the threshold would have to be raised to about 775 ± 60°C-days.

On the other hand drier soil conditions prevail in Russia. According to Agricultural Memorandum No. 341, dry conditions, particularly at flowering time, can increase the accumulated temperature requirements. Thus it is suggested that the original figure (762) might be about right. (This figure applies to early maturing hybrids similar to the Inra and Kelvedon varieties at present being grown as trials in UK).

The method used to arrive at this threshold figure is rather subjective and small changes either way led to large variations in the area on the map above this value. The 60°C-days error margin also needs consideration. The lower limit (702) would include parts of the south and south-east midlands as well as areas more to the south, while the upper limit (822) is only exceeded at Eastbourne and Mildenhall. A more accurate growth parameter is clearly needed.

Map Description by County

The area above 762°C-days is indicated on the map.

Norfolk

Generally well below 762 and one station below 702. Mildenhall (in

/Suffolk

G. 14003/VT/9/70/70

FGS
Stock 34

Suffolk) is very high (824), but this may be a local effect due to the sandy soil. Santon Downham (11 miles to NE of Mildenhall) has a July mean of about 15.7°C. Elsewhere in SE England it was noticed that the July mean needs to exceed 16.2°C for the May to October accumulation to exceed 762°C-days. Thus there is doubt as to where the line should be drawn, but in view of 824 at Mildenhall and 741 at Gorleston on the coast, the extreme south of Norfolk has been included in the area above 762.

Suffolk

, Apart from Mildenhall and Gorleston no other stations in the county have 20 years of record. In view of the figures further south, however, all of Suffolk except the extreme NE and the small area above 400 ft in the SW has been included.

Essex

Apart from urban areas and the small area of higher ground in the NW all the county seems suitable.

Cambridge

The south and south-east are above 762, based upon Mildenhall and Cambridge A small area of south Huntingdon is also included based upon the steady fall between Cambridge (796) and Raunds (733). The boundary is probably determined by the change in soil from clay and heavy fen silts to lighter land in SE Cambridge.

Hertfordshire

Much of the county lies above 400 ft and is probably too cool (Rothamsted (688), St Albans (744) and Eastwick Lodge (762)). Only the SE part of the county seems favourable.

Middlesex

Suitable as regards temperature, but urban areas limit the potential.

Kent

Suitable north of the North Downs and the low lying area around Ashford. The higher parts of the Weald may be too cool (Goudhurst (692)).

Sussex

The high ground of the Weald and South Downs is probably too exposed. The valleys in the Weald and the low ground along the coast remain as probable areas. The stations at Eastbourne (852) and Littlehampton (820) are in urban situations which has increased the accumulation above what would be expected.

Surrey

Apart from the North Downs and Leith Hill much of the county seems suited. The plotted station (Mickleham (713)) is in a valley which experiences low night temperatures and has quite a low accumulation because of this. Low night temperatures may not be significant for maize, provided there is no frost of course.

/Bedford

Bedford

Silsoe (727) and Woburn (693), are both below the threshold and on this evidence the region immediately to the NW of the Chilterns has not been included. The soil type may be important here since heavy land gives way to lighter soil near the Chilterns. This light soil may have the effect of raising the accumulation above the threshold.

Buckingham

The small area south of the Chilterns is included. The northern part of the county is not, but similar arguments apply to the light land just north of the Chilterns as discussed under Bedford.

Berkshire

Eastern and Central parts seem to be above the threshold, based upon 776 at Shinfield. There is also a favoured area around Abingdon (780). All high ground in the west will be too cool.

Oxford

Only the extreme south of the county by the Thames is included.

Wiltshire

In general this county seems too cool. It is difficult to say if the favoured area around Abingdon extends west into Wiltshire. Low lying stations 40 or 50 miles to the SW have accumulations below 702 (Lyneham 694, Lacock 671) and upland sites are lower still (Marlborough 629). The increased proportion of clay soils may be the reason for the lower accumulations. Low ground in the extreme SE of the county may be suitable.

Hampshire

The area north of the Downs seems suitable (South Farnborough 798) and also the low ground of the Hampshire Basin. The other station (Leckford) has 714. This value is low, but making allowance for the low minima it has been marked on the edge of the area.

Much of the Isle of Wight would be sufficiently warm too.

Dorset

No inland stations were available, but the Hampshire area has been continued into the low lying eastern part of the county.

Gloucester

The Cotswolds are omitted, but some uncertainty exists about the region around the Severn. No stations are available and subjective interpolation between Ross-on-Wye (745) and Long Ashton (769) has been used. Since this region is favoured by mild springs, the area has been taken up alongside the Severn Estuary for some distance.

Somerset

Long Ashton (769) and Cannington (816) are above the threshold and on this basis the River Parret region is also included.

/Devon

Devon and Cornwall

On this scale of map only the area around Exeter (769) can be shown. No doubt most of the valleys have sheltered sunny parts where maize could be grown successfully, particularly in view of the mild spring weather. Exposed coastal areas should be avoided due to lodging in Autumn gales. Similar remarks apply to the Scilly and Channel Islands.

The area shown on the map is the 'hard core' maize area in Britain. Even within these areas factors other than climate may prevent good crops from growing. Soil which is slow to warm up in spring is bad for germination, while shallow soil hinders rooting later on and increases the risk of moisture stress during dry weather. Other growing details may be found in Milbourne (1968).

The map is based upon averages for the years 1950 to 1969. These years contained several cool summers and only a slight warming trend in the climate would be required for a larger area in England and Wales to be above the threshold: Hereford, Worcester, Warwick, Leicester and South Lincolnshire also Glamorgan and Monmouth, while in Eire parts of Cork would be sufficiently warm.

Any comments or suggestions on this paper should be sent to the author.

Meteorological Office
Bracknell
Berks.
August 1970

References

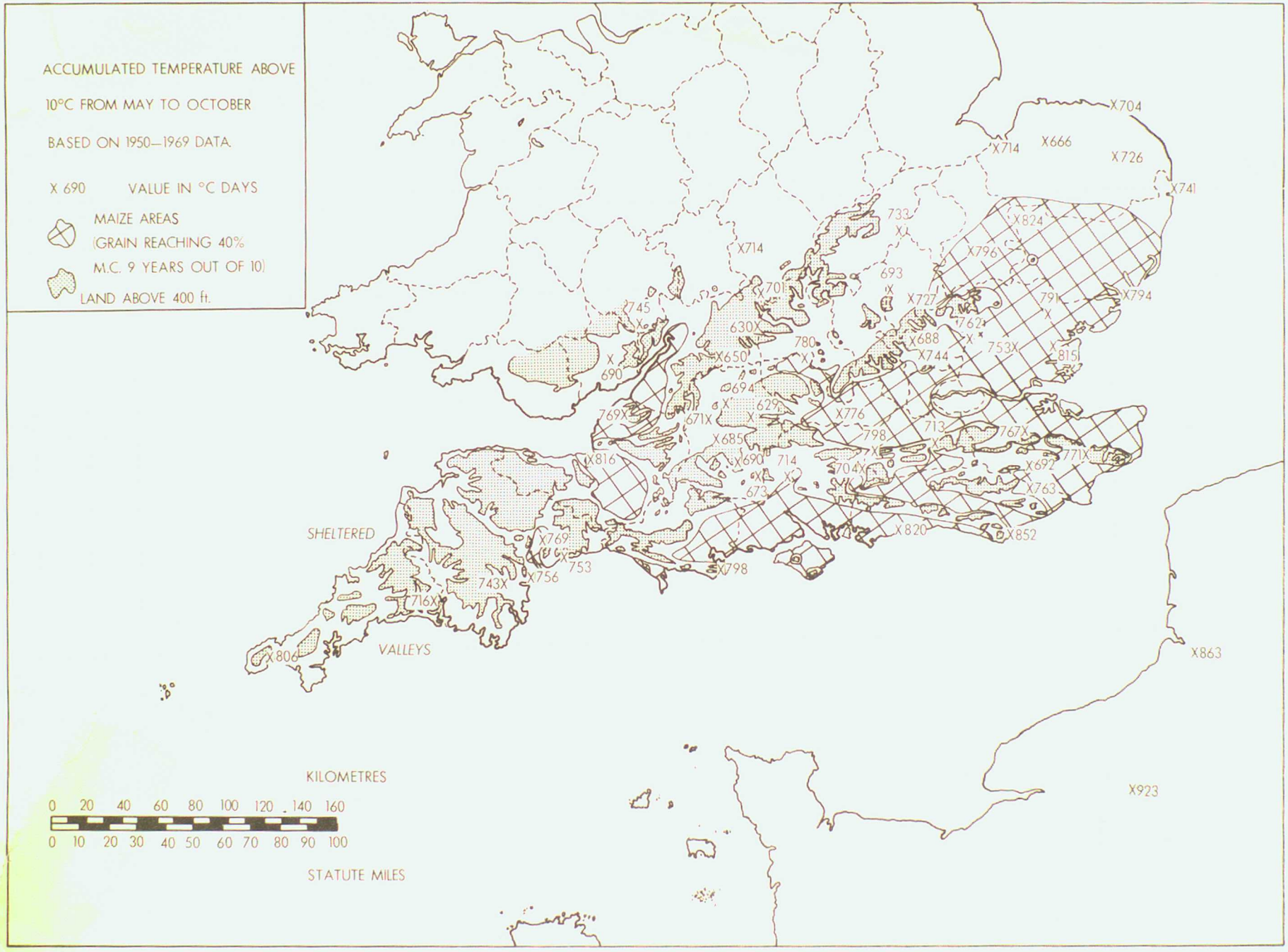
Milbourne, G.M. 1968 Maize for Grain. A Grower's Handbook Wye College, Dept. Agric., Ashford, Kent.

Shellard, H.C. 1959 M.O. Prof. Note 125, Averages of accumulated temperature and the standard deviation of monthly mean temperature over Britain 1921-50. London, H.M.S.O.

Agricultural Memorandum No. 332 Climatically Suited Areas for Grain Maize in UK.

Agricultural Memorandum No. 341 A comparison of Temperature Indices for the Development of Maize.

G. 14003/VT/9/70/70


ACCUMULATED TEMPERATURE ABOVE
10°C FROM MAY TO OCTOBER
BASED ON 1950—1969 DATA.
X 690 VALUE IN °C DAYS
MAIZE AREAS
(GRAIN REACHING 40%
M.C. 9 YEARS OUT OF 10)
LAND ABOVE 400 ft.
SHELTERED
VALLEYS
KILOMETRES
0 20 40 60 80 100 120 140 160
0 10 20 30 40 50 60 70 80 90 100
STATUTE MILES
X704
X714
X666
X726
X741
X824
X796
X794
X714
X727
X744
X776
X798
X767
X771
X692
X763
X820
X852
X798
X806
X863
X923
858X